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UP IN SMOKE: THE UNINTENDED CONSEQUENCES OF MARIJUANA
LEGALIZATION IN THE UNITED STATES ON PUBLIC HEALTH AND SAFETY

by
Claire Gillian Colquitt

A thesis submitted to the faculty of The University of Mississippi in partial
fulfillment of the requirements of the Sally McDonnell Barksdale Honors College and
The Center for Intelligence and Security Studies

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ABSTRACT

The purpose of this research is to explore the potential public health and safety consequences of the legalization of marijuana in the United States. A review of existing literature on the health effects of marijuana use and marijuana's impact on public safety was conducted. Researchers are still unclear as to exactly how marijuana use affects brain structure and function, but some studies indicate that long-term chronic use leads to changes in both neurological function and physical brain structure. Researchers have been unable to identify how marijuana use affects respiratory function and physical health. Finally, marijuana's relationship with psychological health is still unclear. Researchers have found that marijuana use most significantly impacts adolescent psychosocial behavior, but more research is needed to identify exactly how marijuana use relates to mental health. Marijuana's relationship to public safety is also difficult for researchers to pinpoint. Roadway safety is of major concern because of uncertainties about the impairment curve of the main psychoactive substance in marijuana, THC. Until better methods of identifying impairment due to marijuana use are implemented, laws regarding driving under the influence of marijuana will either be ineffective or too strict. It is also difficult to determine exactly how both the availability and use of marijuana contribute to violent crime in America. The present study conducted structured interviews with five professionals in agencies or organizations that deal with marijuana to identify potential consequences of marijuana legalization. The interviews demonstrated a similar amount of uncertainty as found in existing literature. Law enforcement is still divided on the issue, as well as legislators and lawyers. The majority of participants viewed the legalization of marijuana as a positive step for the United States, with the largest safety concern being roadway safety. These results reflect the changing popular opinion in the United States regarding marijuana and its legalization, and participants noted that the public remains relatively well informed about many of the issues surrounding marijuana.

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CHAPTER I: INTRODUCTION

Marijuana's History

Mankind has enjoyed a long relationship with substances that alter mood and perception. One such substance is marijuana, most commonly grown from *Cannabis sativa* or *Cannabis indica*, members of the hemp family Cannabaceae (“What Are the Differences between Cannabis Indica and Cannabis Sativa, and How Do They Vary in Their Potential Medical Utility? ,” 2015). *Cannabis sativa* originally came from Southeast Asia and South Central America, while *Cannabis indica* came from the Middle East and North Africa (“What Are the Differences...?”). Both produce similar effects in humans, with *Cannabis sativa* producing more of a euphoric “high” and *Cannabis indica* being more of a muscle relaxant and analgesic (“What Are the Differences...?”).

References to the use of these plants for industrial as well as medicinal use date back to ancient cultures such as the Chinese, who brewed tea with the leaves as a cure for anxiety and pain as far back as 2737 B.C. (Brecher, 1972). Other cultures such as the ancient Indians used hashish, the dried resin of the marijuana plant, for medicinal purposes as well (Brecher, 1972). *Cannabis sativa* and *Cannabis indica* are more commonly known by other names, and the popular names for the plants have changed much like fashion over time depending on the plants’ use and popularity. For industrial purposes, any member of the Cannabaceae family is referred to as “hemp”, and the fibers of these plants can be used for various purposes ranging from clothing to rope to lotion to soap (Brecher, 1972). The variants of the Cannabaceae family used for human consumption, however, are referred to by a variety of names: marijuana or marihuana,

pot, weed, dope, kush, grass, and many others too bizarre to mention (Brecher, 1972). For the purposes of this paper, I will refer to the processed product consumed by users as simply cannabis or marijuana, with the industry as a whole being referred to as the marijuana industry.

Marijuana's history in the United States has been tumultuous. Settlers of the Jamestown colony brought the plant to Virginia in 1611 to grow for fiber, and the plant was brought to New England in 1629 (Brecher, 1972). Cannabis plants grown in America prior to the Civil War had medicinal as well as practical uses, including using hemp fibers for rope and parchment (Brecher, 1972). Marijuana cultivation declined following the Civil War, but the plant remained far from scarce (Brecher, 1972). Commercial growth of marijuana was expanded to increase rope production during World War II (Brecher, 1972). Marijuana was additionally used for a variety of medicinal purposes between 1850 and 1937, sold under the name *Extractum Cannabis* (Brecher, 1972). Tinctures and extracts containing marijuana were sold over-the-counter in pharmacies or prescribed by physicians, and one pharmacy even sold marijuana cigarettes to treat asthma (Brecher, 1972).

Recreational marijuana remained moderately popular in America until it became associated with immigrants and African-Americans, at which point temperance groups across the country called for its prohibition (Brecher, 1972). Under the guidance of Harry Aslinger, the Federal Bureau of Narcotics was created in 1930 with the goal of making marijuana illegal in the United States (Brecher, 1972). The Marijuana Tax Act was enacted in 1937 and cannabis fell under the regulation of the Drug Enforcement Agency (DEA) (Brecher, 1972). This Act criminalized cannabis use and possession for any

purpose under federal law (Brecher, 1972). Marijuana saw a resurgence of use in the 1960s and 1970s (Brecher, 1972). This prompted the beginning of the War on Drugs enacted by President Nixon. The Controlled Substance Act of 1970 created a classification system for narcotics and gave two government agencies, the DEA and the Food and Drug Administration, control over the regulation of marijuana (Controlled Substances Act, 1970). Marijuana is still classified as a Schedule I drug, meaning that it has high potential for abuse and addiction and has no known medical purpose. Other Schedule I substances include heroin and LSD (United States Drug Enforcement Agency, 2015).

Modern research on marijuana's medicinal values has spurred a loud and growing movement to legalize the plant for medicinal purposes. Patients in 23 states now have access to medical marijuana to treat a variety of chronic ailments, and more states are adding medical marijuana initiatives to their ballots ("23 Legal Medical Marijuana States and DC", 2015). Legalizing marijuana for recreational use is also a hot topic, especially in Western states. In 2012, Washington and Colorado made history in the United States by voting to legalize marijuana for recreational use (KKTV/AP, 2013; Martin, 2012). These two states have pushed their way through uncharted legal territory while cannabis remains a federally banned substance. As more states legalize marijuana despite unchanging federal laws, legislators will have to deal with the unintended consequences of legalization without the help of the federal government.

Many of the larger questions faced by lawmakers in dealing with marijuana legalization have to do with public health and safety. State and federal legislators lack clear and accurate information about marijuana use in the general population and are

unable to predict how legalization will impact public health and safety. Many new studies are being published about marijuana's effects on physical and psychological health as policymakers search for information to write effective and safe legislation. Both federal and state organizations across the United States are looking to Colorado and Washington as experiments that will determine how marijuana's legalization is implemented in other states. Colorado is now providing more accurate data regarding the prevalence of marijuana use now that the substance is legal, as well as demographic information on users (Blake & Finlaw, 2014). Colorado has been able to measure changes in marijuana consumption since legalization with relative accuracy, aiding other states and organizations in projecting how marijuana use will increase as the substance is legalized (Blake & Finlaw, 2014).

Current Statistics on Marijuana Use in the U.S.

Current estimates in the United States state that marijuana use has been increasing since 2007 (National Institute on Drug Abuse, 2014). In 2012, according to the National Institute on Drug Abuse, an estimated 18.9 million Americans over the age of 12 identified as current users, meaning that they had used at least one time in the preceding month. This equates to 7.3 percent of the American population age 12 or older. Marijuana use since 2007 has increased by 1.5 percent among Americans above the age of 12 (National Institute on Drug Abuse, 2014). Among youths under the age of 18, marijuana use has remained relatively stable over the past five years (National Institute on Drug Abuse, 2014). Attitudes towards marijuana are changing among this population, though (National Institute on Drug Abuse, 2014). In 2014, just 36.1 percent of high school seniors said that regular marijuana consumption puts the user at risk (National Institute

on Drug Abuse, 2014). In 2009, the number of high school seniors answering that way was 52.4 percent (National Institute on Drug Abuse, 2014). In 2014, 6.5 percent of American eighth graders reported past-month use, compared to 16.6 percent of 10th graders and 21.2 percent of 12th graders (National Institute on Drug Abuse, 2014). About 6 percent of 12th graders reported daily marijuana use in 2014, and 81 percent reported that marijuana “is easy to get.” (National Institute on Drug Abuse, 2014)

Most marijuana users in 2014 were between the ages of 18 and 25 (National Institute on Drug Abuse, 2014). Just over 19 percent of participants in a national survey that fell into this age bracket reported using marijuana in the past month, compared to just 5.6 percent of participants over the age of 26 (National Institute on Drug Abuse, 2014). In terms of lifetime use prevalence, 43.7 percent of participants over the age of 12 reported using marijuana at least once in their lifetime (National Institute on Drug Abuse, 2014). However, a 2013 Pew Research study found that 48 percent of adults said that they had tried marijuana, with 12 percent reporting past-year use (Pew Research Center, 2013). According to this study, 56 percent of “young people” had tried marijuana and 27 percent reported past-year use, but the term “young people” was not clearly defined (Pew Research Center, 2013).

The relationship between marijuana and mortality is still unclear. Two recent deaths in Colorado have been attributed to acute marijuana intoxication, but it was not an overdose of THC that killed either (Crimesider Staff, 2014). Researchers have been able to demonstrate that it is virtually impossible to overdose on THC to the point of death, but THC consumption can produce erratic or psychotic behavior that in extreme cases could lead to accidental death (National Institute on Drug Abuse, 2014). Because

marijuana has been illegal for much of modern American history, it is unclear whether marijuana itself has a link to increased violent crime. Proponents of marijuana legalization argue that marijuana's prohibition has contributed to crime much like alcohol prohibition did during the 1920s. Whether that argument proves true has yet to be seen, as a sizeable black market for marijuana still exists even in states where marijuana is now legal (Healy, 2014).

As changing laws and attitudes bring marijuana out of the dark and into legitimate markets, new research and information will give policymakers and law enforcement agencies a clearer picture of the interactions between marijuana consumption and public health and safety (Caulkins, Kilmer, Kleiman, MacCoun, Midgette, Oglesby, Pacula, & Reuter, 2015). While some argue that legalized marijuana will create a lawless and violent society similar to the picture painted by the 1936 film *Reefer Madness*, others maintain that marijuana will do no more harm than substances like tobacco and alcohol that are already legal (Caulkins, et al., 2015). This study seeks to examine the possible consequences of marijuana's legalization on both public health and public safety, with special attention to roadway safety. By examining existing literature as well as conducting interviews with personnel working in positions that deal closely with marijuana, I hope to provide a clearer picture of the ways in which legalized marijuana can impact the health and safety of Americans.

The present study seeks to answer the following research questions:

1. Will the legalization of marijuana have a positive or negative impact on public health in the United States?
2. How will legalized marijuana affect roadway safety in the United States?

3. Have state or local agencies started preparing for legal marijuana, and what kinds of preparations are they making?
4. Will legalized marijuana be a net cost or net benefit for Americans?

I hope to answer the above research questions by interviewing professionals in offices and agencies closely involved with marijuana and its surrounding issues.

CHAPTER II: LITERATURE REVIEW

Chemical Effects of Marijuana

To more deeply understand the widespread effects that the legalization of marijuana would have on the American public and economy, it first makes sense to understand how marijuana affects the body. A deeper understanding of how marijuana works and how it chemically alters the body can illustrate how marijuana impacts broad sectors of society such as public health and roadway safety. Marijuana is classified by the DEA as a Schedule I drug, meaning that it has no medical use and has a high likelihood of abuse and addiction (United States Drug Enforcement Agency, 2015). Marijuana chemically alters brain functions by mimicking chemicals found naturally in the body, impairing concentration, memory, movement, and coordination (National Institute on Drug Abuse, 2014).

The active chemical in marijuana is tetrahydrocannabinol (THC) and closely resembles the structure of cannabinoid chemicals that occur naturally in the body, called endogenous cannabinoids (National Institute on Drug Abuse, 2014). These chemicals are neurotransmitters that send messages between neurons in the brain and the rest of the nervous system (National Institute on Drug Abuse, 2014). The areas of the brain most associated with the receptors for endogenous cannabinoids are the hippocampus, basal ganglia, amygdala, cerebellum, ventral striatum, neocortex, and the brain stem and spinal cord; these are the primary areas responsible for pleasure, concentration, memory, coordination, movement, and sensory and time perception (National Institute on Drug Abuse, 2014). The areas closely associated with cannabinoid receptors also deal with

pain modulation, rapid eye movement sleep, mood, and higher-order processes (National Institute on Drug Abuse, 2014).

All of these areas factor into normal human brain function and influence the ways that we behave and relate to other people and stimuli (National Institute on Drug Abuse, 2014). Because THC so closely resembles endogenous cannabinoids in structure, it attaches to the cannabinoid receptors in the brain and floods the nervous system with messages to that part of the brain (National Institute on Drug Abuse, 2014). This activates the parts of the brain associated with endogenous cannabinoids, causing disturbances to normal brain function (National Institute on Drug Abuse, 2014). This produces the effects that marijuana users are familiar with: feelings of pleasure and relaxation, distorted perception of time, heightened sensory experiences, and slow motor function (National Institute on Drug Abuse, 2014).

Long-Term Effects of Marijuana Consumption

Studies indicate that long-term marijuana use causes the down-regulation of the endogenous cannabinoids that THC mimics and changes the physical structures of the brain. New fMRI imaging has demonstrated clear structural changes in the brains of chronic marijuana users (Filbey, Aslan, Calhoun, Spence, Damaraju, Caprihan, & Segall, 2014; Volkow, Baler, Compton, & Weiss, 2014). Researchers are still unsure of why these structural changes occur, but working theories point to the possibility that the brain may overcompensate for weaknesses caused by chronic THC exposure (Volkow, Baler, Compton, & Weiss, 2014). The body becomes accustomed to receiving regular amounts of THC and stops producing its own neurotransmitters, so it becomes dependent on THC

to activate the parts of the brain normally activated by endogenous cannabinoids (Volkow, Baler, Compton, & Weiss, 2014).

Furthermore, this causes the parts of the brain associated with endogenous cannabinoids to function poorly (Volkow, Baler, Compton, & Weiss, 2014). They do not receive enough neurotransmitters unless THC is present in the body, meaning that the brain cannot effectively communicate with areas such as the hippocampus and cerebellum (Volkow, Baler, Compton, & Weiss, 2014). This is why long-term chronic marijuana users tend to have impaired concentration, low motor function, and feelings of listlessness when not under the influence of marijuana (Volkow, Baler, Compton, & Weiss, 2014). However, many of these changes are reversible after at least four weeks of abstinence (Volkow, Baler, Compton, & Weiss, 2014). Chronic users can regain some lost brain function, but researchers are still unclear as to how much lost brain function can be regained (Volkow, Baler, Compton, & Weiss, 2014).

Several studies have been conducted on the long-term use of marijuana and its effects on brain function with contradictory results. Some studies have demonstrated several negative effects associated with long-term marijuana use, while others found no negative results. One study conducted by several researchers from Texas and New Mexico in 2014 found that when used chronically over long periods of time, marijuana changes the amount of gray matter in the brain (Filbey, et al., 2014). Gray matter in the orbitofrontal area was significantly impacted (Filbey, et al., 2014). The orbitofrontal area includes the prefrontal cortex, which is responsible for higher-level thinking (Filbey, et al., 2014). However, marijuana users had higher levels of resting activity in the orbitofrontal area, meaning that the neurons in that area fire almost randomly (Filbey, et

al., 2014). The researchers discussed the possibility of this increased neuron activity being related to decreased production of endogenous cannabinoids (Filbey, et al., 2014). The brain overcompensates for a lack of endocannabinoids by firing too much in the presence of THC (Filbey, et al., 2014).

Another study conducted in 2013 had similar findings (Battistella, Fornari, Annoni, Chtioui, Dao, Fabritius, Favrat, Mall, Maeder, Giroud, & Christian, 2014). Researchers found that chronic marijuana use decreased the amount of gray matter in the regions of the brain associated with higher-order thinking, motivational, emotional, and affective processing (Battistella, et al., 2014). These areas include the orbitofrontal cortex, medial temporal cortex, and parahippocampal gyrus (Battistella, et al., 2014). The researchers also found that the reduction in gray matter was proportional to the frequency of usage within the three months prior to the study (Battistella, et al., 2014).

A team of researchers from the National Institute on Drug Abuse studied the effects of long-term marijuana use in their 2014 article, “Adverse Health Effects of Marijuana Use.” Marijuana’s effects on brain development are striking in adolescent users, having profound effects on several areas of neurological and psychosocial development (Volkow, Baler, Compton, & Weiss, 2014). The human brain continues to undergo rapid and active development until approximately 21 years of age, in which the brain experiences physical changes (Volkow, Baler, Compton, & Weiss, 2014). If the brain is exposed to marijuana during this development, especially in adolescent years, reward and pleasure centers can be “recalibrated”, indicating that marijuana use during developmental years can produce fundamental changes in learning and social behavior (Volkow, Baler, Compton, & Weiss, 2014). The researchers found similar results to the

previously mentioned studies in neural connectivity among marijuana users. This reduced amount of neural fibers was especially pronounced in areas critical to learning, memory, and high-integration activities such as alertness and self-awareness (Volkow, Baler, Compton, & Weiss, 2014). Furthermore, adolescent onset of marijuana use is correlated with a decline in IQ (Volkow, Baler, Compton, & Weiss, 2014). These changes indicate that certain areas of the brain are more susceptible to adverse effects of marijuana than others, but more research in this area is needed (Volkow, Baler, Compton, & Weiss, 2014).

Despite the numerous studies that demonstrated changes in brain structure among chronic marijuana users, a recent study found otherwise (Weiland, Thayer, Depue, Sabbineni, Bryan, & Hutchison, 2015). Researchers at the University of Colorado used brain imaging to study the physical differences in the brain structure of daily marijuana users compared to non-users (Weiland, et al., 2015). Participants were more closely matched on the alcohol problem measure (AUDIT) test, and results were controlled for other substance use (Weiland, et al., 2015). Other measures were implemented to control for other variables such as depression and impulsivity (Weiland, et al., 2015). The researchers found no significant differences in the volumes of the brain areas studied: the accumbens, amygdala, hippocampus, and cerebellum (Weiland, et al., 2015). They noted that the previous studies finding brain structure and volume differences in marijuana users failed to adequately control for alcohol use, and that alcohol use is proven to significantly impact gray matter volume (Weiland, et al., 2015). This study highlights the need for further research that isolates marijuana use to study the effects of marijuana use

alone, separating confounding variables such as alcohol and tobacco use (Weiland, et al., 2015).

Marijuana and Addiction

One of the more controversial areas surrounding marijuana is addiction.

Proponents of marijuana's legalization, both for medical and recreational purposes, claim that marijuana is not an addictive substance and users face little to no adverse effects from marijuana (Bellville, 2014). Recent studies on marijuana's addictiveness indicate otherwise (Volkow, Baler, Compton, & Weiss, 2014). Volkow, et. al. also discuss the subject of addiction in "Adverse Health Effects of Marijuana Use." Over time, about nine percent of marijuana users will qualify as addicts according to the definition of addiction in the *Diagnostic and Statistic Manual of Mental Disorders*, 5th edition [DSM-V] (Volkow, Baler, Compton, & Weiss, 2014).

When studying marijuana users who began using as teenagers, the number of addicts increases to 16 percent (Volkow, Baler, Compton, & Weiss, 2014). Even more disturbing, 25 to 50 percent of daily marijuana users can be classified as dependent according to the DSM-V (Volkow, Baler, Compton, & Weiss, 2014). Cannabis withdrawal syndrome is informally recognized as well, with symptoms making relapse more likely and users less likely to quit (Volkow, Baler, Compton, & Weiss, 2014). These symptoms include irritability, craving, anxiety, and difficulty sleeping (Volkow, Baler, Compton, & Weiss, 2014). Because of the increased activity in brain development during adolescence, teenagers that use marijuana are significantly more likely to exhibit signs of marijuana dependence within the first two years of use (Volkow, Baler, Compton, & Weiss, 2014).

Effects of Marijuana Consumption on Adolescents

The neurological changes found in long-term users that began use during adolescence also factor into the lifetime education and achievements of users (Volkow, Baler, Compton, & Weiss, 2014). For example, adolescent-onset users are more likely to drop out of high school and face adulthood difficulties in achievement (Dougherty, et al., 2012). Adolescents that frequently consume marijuana face more learning difficulties due to changes in brain structure and function, and are less likely to seek help in improving poor school performance (Dougherty, et al., 2012). Marijuana use is a consistent and significant indicator of poor grades in school, especially as the age of first use decreases (Palamar, Fenstermaker, Kamboukos, Ompad, Cleland, & Weitzman, 2014). Furthermore, long-term marijuana use correlates with unemployment, lack of higher education, dependence on social welfare programs, and low socioeconomic status (Volkow, Baler, Compton, & Weiss, 2014).

Previous studies already discussed have demonstrated the effects of marijuana use in long-term users that initiated consumption during adolescence. Many studies on the effects of marijuana have noted the increased consequences of marijuana exposure during times of rapid brain development, particularly adolescence. One particular study conducted in 2011 measured high school seniors in North Carolina, comparing students that did not use marijuana to students that self-reported as using marijuana at least four days per week for at least the prior six months (Dougherty, et al., 2012). Researchers found that 77 percent of the students that used marijuana met the criteria for marijuana abuse or dependency according to the DSM-IV (Dougherty, et al., 2012). Furthermore, these students tested poorly on measures of attention and memory (Dougherty, et al., 2012). Marijuana users also had higher rates of impulsivity and decision-making errors

(Dougherty, et al., 2012). The marijuana users that participated in the study had to abstain from marijuana use for six weeks in order to participate in the study, and the cognitive differences measured in those participants was still significant (Dougherty, et al., 2012). This demonstrates that adolescent marijuana use impacts neurological and psychological development in ways that cannot be completely reversed by abstinence.

Another study comparing marijuana use and alcohol use among high school users found similar results. Researchers were unclear as to the reasons for some findings, marijuana use was found to be more harmful to relationships with teachers and parents than alcohol use (Palamar, Fenstermaker, Kamboukos, Ompad, Cleland, & Weitzman, 2014). Both adolescent marijuana users and adolescent alcohol users were equally likely to report illegal involvement related to substance use and involvement, but more negative stigma was associated with marijuana use (Palamar, Fenstermaker, Kamboukos, Ompad, Cleland, & Weitzman, 2014). Frequent marijuana use, defined as reporting using the substance at least 40 times prior to the study, was associated with being 23 times more likely to reporting trouble with law enforcement (Palamar, Fenstermaker, Kamboukos, Ompad, Cleland, & Weitzman, 2014). Marijuana use in adolescents was associated with low energy, low interest in activities, and low performance in school and other academic activities (Palamar, Fenstermaker, Kamboukos, Ompad, Cleland, & Weitzman, 2014). Interestingly, alcohol was much more frequently associated with unsafe driving behaviors at 19.9 percent of users, whereas marijuana use was only associated with unsafe driving in 8.8 percent of users (Palamar, Fenstermaker, Kamboukos, Ompad, Cleland, & Weitzman, 2014). This finding has the highest implication for public safety, but as

marijuana use becomes more socially acceptable the number of roadway fatalities in adolescents due to marijuana use may rise.

Roadway Safety

While law enforcement agencies and lawmakers in the United States treat marijuana much like alcohol in terms of driving impairment, science is still trying to understand just how marijuana affects driving behavior and safety. Research on driving under the influence of marijuana tends to be contradictory. Some researchers have found that marijuana intoxication does not significantly impact driving behavior, while others demonstrated that drivers were more likely to display unsafe attention levels to their driving behavior while under the influence of marijuana. Most laws in place against driving under the influence of marijuana in the United States are based on research that demonstrated significant levels of impairment in drivers with measurable levels of THC metabolite in whole blood.

The number of drivers on U.S. roadways testing positive for cannabinoids has increased since 2007 (Berning, Compton, & Wochinger, 2015). The National Highway Traffic Safety Administration found that weekend nighttime drivers testing positive for cannabinoids increased 48 percent from 2007 to 12.6 percent of drivers tested (Berning, Compton, & Wochinger, 2015). The number of weekend nighttime drivers testing positive for prescription medications, however, remained relatively stable at 4.9 percent of drivers tested (Berning, Compton, & Wochinger, 2015). Drivers testing positive for alcohol have also declined steadily since 1973, dropping from 35.9 percent to 8.3 percent (Berning, Compton, & Wochinger, 2015). Though this number is lower than the number of drivers testing positive for cannabinoids, alcohol remains in the body for a much

shorter period of time than marijuana (Berning, Compton, & Wochinger, 2015). The high number of drivers testing positive for cannabinoids does not necessarily mean that more Americans are driving while impaired (Berning, Compton, & Wochinger, 2015). The Administration included marijuana in the “illegal drugs” category despite the high number of states in which it is used for medicinal purposes, and the authors noted that the large increase in the number of drivers testing positive for cannabinoids may have been due to relaxing marijuana laws across the U.S. (Berning, Compton, & Wochinger, 2015).

The difficulty in creating effective legislation for prosecuting drivers under the influence of marijuana is mainly in identifying and prosecuting drivers that are actually impaired at the time of arrest. Few studies have been conducted in the United States to further understand the possible links between blood THC or cannabinoid levels and impairment. One study conducted on rhesus monkeys in Texas found that there was no correlation between the blood levels of THC and behavioral impairment. The presence of THC did cause some physiological responses in the monkeys including elevated temperature and response rate. However, there was no direct correlation between the amount of THC and any distinct physiological response (Ginsburg, Hrubá, Zaki, Javors, & McMahon, 2014).

A study published 2010 examined the possibility of differentiating recent marijuana use from residual cannabinoids. Long-term frequent marijuana users checked in to a closed location for 30 days, where they abstained from any marijuana use (Schwilke, Gullberg, Darwin, Chiang, Cadet, Gorelick, Pope, & Huestis, 2010). Their urine was examined for the duration of their stay, measuring for THCCOOH glucuronide (THC metabolite), the cannabinoid substance marker measured in urinalysis drug tests

that signifies marijuana use (Schwilke, et al., 2010). Depending on frequency of use, this metabolite can remain in urine for weeks (Schwilke, et al., 2010). In occasional users, peak THC metabolite concentration occurs between 10 and 18 hours after consumption, long after peak impairment (Schwilke, et al., 2010). The researchers were able to develop a ratio for determining the difference between recent use and residual THC metabolite by using two urine samples collected between 48 and 720 hours apart (Schwilke, et al., 2010). This was the first model of its kind developed, and provides a method for ensuring marijuana abstinence in users with high residual THC metabolite levels (Schwilke, et al., 2010). However, this model is limited in that it does not determine when the first use occurred (Schwilke, et al., 2010). For example, a person suspected of driving under the influence of marijuana who provides a urine sample to measure for THC metabolite would have no way of proving that their marijuana consumption occurred outside of the normal window of impairment. Furthermore, law enforcement would have no way of proving that the suspect was impaired at the time arrest using only urinalysis for THC metabolite. Though this study provided a great deal of insight into how quickly the body metabolizes THC and excretes its metabolites, it exemplifies the limitations that exist in determining an impairment and metabolism curve similar to that of alcohol.

Another study examined the correlation between blood THC levels and driving performance in Australia. Participants were given marijuana cigarettes containing varying levels of THC and then asked to complete Standardized Field Sobriety Tests (SFSTs) (Papafotiou, Carter, & Stough, 2005). The researchers found that driving behavior was significantly impaired 80 minutes after consuming marijuana, and SFSTs correctly identified the participants as impaired between 65 and 76 percent of the time (Papafotiou,

Carter, & Stough, 2005). In participants whose driving behavior was identified as impaired, SFSTs correctly identified impairment 84 to 100 percent of the time (Papafotiou, Carter, & Stough, 2005). This indicates that SFSTs are useful in identifying drivers that have already demonstrated their impairment, but may not be effective in identifying drivers under the influence of marijuana when the driver's behavior is not indicative of impairment. The study upheld previous research that marijuana impairment increases poor driving behavior due to increased reaction times, shorter attention span, and impaired critical thinking ability. The study also showed that consuming marijuana cigarettes of doses as low as 1.7 percent THC can significantly impair driving ability (Papafotiou, Carter, & Stough, 2005).

A 2014 study out of California looked at the prevalence of marijuana intoxication among drivers in states in America that had implemented medical marijuana laws since 1992. The study used data from 1992 to 2009 in the Fatality Analysis Reporting System, which measured the cannabinoid presence in drivers involved in fatal crashes (Masten & Guenzburger, 2014). The states studied were Alaska, California, Colorado, Hawaii, Maine, Maryland, Michigan, Montana, Nevada, New Mexico, Oregon, Rhode Island, Vermont, and Washington (Masten & Guenzburger, 2014). These particular states were examined in order to determine if medical marijuana legislation caused an increase in the number of fatal crashes due to marijuana intoxication (Masten & Guenzburger, 2014). Drivers in states with medical marijuana were more likely to be tested for drugs following a crash, with about 2 percent of all drivers in the United States involved in fatal crashes testing positive for cannabinoids (Masten & Guenzburger, 2014). In states with medical marijuana, though, 2.7 percent of drivers tested positive for cannabinoids

(Masten & Guenzburger, 2014). In crashes where the driver was fatally injured, 3.2 percent of drivers tested positive for cannabinoids (Masten & Guenzburger, 2014). This rate was higher in jurisdictions with medical marijuana, at 4.6 percent (Masten & Guenzburger, 2014). Overall, only three of the states measured saw a relationship between the implementation of medical marijuana laws and an increase in the number of drivers that tested positive for cannabinoids: California, Hawaii, and Washington (Masten & Guenzburger, 2014). However, the findings indicated that the medical marijuana laws provided marijuana to a specific subset of the population rather than increasing the number of marijuana users overall (Masten & Guenzburger, 2014). This increase in the number of drivers that tested positive for cannabinoids following a fatal crash does not necessarily mean that they were impaired at the time of the crash. Because of the ways that marijuana is metabolized and stored in the body as mentioned previously, it is possible for a driver to test positive for cannabinoids even if they have not consumed marijuana for a significant period of time (Masten & Guenzburger, 2014).

Colorado has presented a wealth of data since legalizing marijuana recreationally in 2012. The University of Colorado conducted a study to examine the effects of relaxing marijuana legislation on roadway safety (Salomonsen-Sautel, Min, Sakai, Thurstone, & Hopfer, 2014). This study utilized the same data system as the previous study, the Fatality Analysis Reporting System. Colorado researchers studied data from 1994 to 2011, looking at the number of drivers involved in fatal crashes that tested positive for cannabinoids (Salomonsen-Sautel, Min, Sakai, Thurstone, & Hopfer, 2014). In 1994, the number of drivers that tested positive for cannabinoids was 4.5 percent; by 2011, this number had increased to 10 percent (Salomonsen-Sautel, Min, Sakai, Thurstone, &

Hopfer, 2014). In states without marijuana legislation, the number of drivers involved in fatal crashes that tested positive for cannabinoids was just 4.1 percent (Salomonsen-Sautel, Min, Sakai, Thurstone, & Hopfer, 2014). Researchers found that the spike in marijuana-related fatal crashes was unique in Colorado and was attributed to marijuana commercialization in the state (Salomonsen-Sautel, Min, Sakai, Thurstone, & Hopfer, 2014). Nationally and in Colorado, the percentage of drivers that test positive for alcohol following a fatal crash is decreasing (Salomonsen-Sautel, Min, Sakai, Thurstone, & Hopfer, 2014). The researchers indicated that the increase in the number of drivers testing positive for marijuana and the increased availability of marijuana were likely related (Salomonsen-Sautel, Min, Sakai, Thurstone, & Hopfer, 2014). Again, the authors of this study noted that testing positive for cannabinoids does not equate to marijuana impairment (Salomonsen-Sautel, Min, Sakai, Thurstone, & Hopfer, 2014). More research into identifying exactly how measurable cannabinoid levels relate to impairment is necessary before any direct relationships can be measured.

A report published in 2007 examined existing literature and made suggestions for policymakers looking to write improved DUIC (Driving Under the Influence of Cannabis) legislation. This report found no existing basis for the creation of *per se* laws in regards to marijuana because there is no proven direct link between measurable blood THC level and impairment, unlike alcohol (Grotenhermen, Leson, Berghaus, Drummer, Krüger, Longo, Moskowitz, Perrine, Ramaekers, Smiley, & Tunbridge, 2007). Few studies have found general correlations, but the blood THC found was significantly higher than existing *per se* laws (Grotenhermen, et al., 2007). Furthermore, the margin of error in laboratory testing would increase the number of false positives if the *per se* limits

were set too low (Grotenhermen, et al., 2007). The report suggested that if legislators decided to pursue *per se* limits in their jurisdictions, the minimum blood THC level that should be used is 7 nanograms per milliliter of whole blood, which would roughly equate to a BAC of about 0.05 percent (Grotenhermen, et al., 2007). However, due to the inherent biological differences in marijuana users and therefore the time needed for each person's body to completely eliminate THC and THC metabolites, the authors did not recommend using *per se* legislation to prosecute drivers charged with DUIC (Grotenhermen, et al., 2007).

Marijuana Legislation and Illegal Use

One important aspect of legalization to consider is the effect that marijuana legislation will have on illegal marijuana use. Anti-legalization advocates often argue that legalizing marijuana leads to increased illegal consumption because more people have access to the substance. Several studies have been conducted attempting to link the passage of marijuana legislation, whether medical or recreational, to increases in illegal use. In states with medical marijuana legislation, illegal use refers to consumption of marijuana by anybody without a prescription or appropriately issued medical marijuana card. In states with recreational marijuana legislation, illegal use refers to consumption by people under the legal age limit, which in all states with recreational legislation is 21 years ("Marijuana Policy in the States", 2014).

A study conducted by a graduate student at Michigan State University looked at arrest data from across the U.S. from 1988 to 2008 at the city level (Chu, 2014). Data were obtained from the Uniform Crime Reports (UCR) system to look at marijuana possession arrests and the Treatment Episode Data Sets (TEDS) to look at state-level

marijuana treatment admissions (Chu, 2014). The UCR is data compiled by the FBI every month consisting of police records from state and local agencies (Chu, 2014). The UCR does not account for multiple arrests of the same person, so each record does not necessarily equate with a separate individual (Chu, 2014). Chu found that medical marijuana legislation was associated with a 10 to 20 percent increase in marijuana arrests and treatments (Chu, 2014). The study demonstrated a strong positive correlation with medical marijuana legislation and increased arrests for illegal marijuana use, although the author of the study noted that the increase was not particularly large (Chu, 2014).

Another study examined California specifically, looking at the relationship between the passage of medical marijuana legislation and overall marijuana use in 50 cities across the state (Freisthler & Gruenewald, 2014). Researchers conducted a telephonic survey study with 8,853 participants in 50 randomly chosen California cities (Freisthler & Gruenewald, 2014). The surveys were conducted in 2009 and 2010 (Freisthler & Gruenewald, 2014). The researchers found that areas with greater physical availability of marijuana did not have higher frequencies of lifetime use. However, participants that lived in areas with greater physical availability were more likely to be current users (Freisthler & Gruenewald, 2014). Researchers found that the societal structure of cities did have an impact on prevalence of current marijuana use (Freisthler & Gruenewald, 2014). Cities that had higher levels of “collective efficacy” and higher levels of “social disorder” had higher rates of both lifetime and current marijuana use (Freisthler & Gruenewald, 2014). The researchers noted that this demonstrates a more complex relationship between the availability of marijuana and overall prevalence of use (Freisthler & Gruenewald, 2014).

Marijuana and Crime

Pro-legalization advocates often argue that legalizing marijuana will decrease the impact of drug trafficking organizations in the U.S. and therefore decrease the amount of violent crime that occurs as a result of the illegal trafficking and sale of marijuana. Very few studies exist regarding the connection between marijuana and violent crime because there are not many credible sources of data available. Most data that exists is extrapolated from estimates and public surveys, but both forms of data collection are open to skewed results. It is important to consider crimes associated with trafficking marijuana into the U.S. as well as crimes associated with marijuana use.

Trafficking data is a bit easier to find, but most numbers are still estimates. Current statistics from the United States Drug Enforcement Agency state that from 2010 to 2013, between 1.3 and 1.4 million kilograms per year of marijuana were seized along the Southwest border (United States Drug Enforcement Agency, 2014). Mexican drug trafficking organizations are responsible for most of the marijuana brought into the U.S., and it is estimated that they make up to 26 percent of their profits from trafficking marijuana (Kilmer, 2013). It is estimated that Mexican drug trafficking organizations made between six and eight billion dollars bringing drugs into the U.S. in 2008, and that number is projected to have risen (Kilmer, 2013). Prior to 2012, the Mexican Institute of Competitiveness estimated that Mexican cartels stood to lose billions of dollars as a result of marijuana legalization in Colorado, Washington, and Oregon (Ramsey, 2012). Despite the potential financial loss that legalizing marijuana in the U.S. would have on these organizations, it is extremely unlikely that drug trafficking would completely cease (Ramsey, 2012). The crimes associated with drug trafficking would therefore still occur in the U.S., including assault, murder, money laundering, possession of illegal weapons,

and theft (United States Sentencing Commission, 2013). It is unclear exactly how the prevalence of these crimes would decrease if marijuana were legalized in the U.S.

The United States Sentencing Commission (USSC) provides statistics about drug arrests and other drug crimes in the United States. In 2013, there were 22,215 drug trafficking cases reported to the USSC (United States Sentencing Commission, 2013). Of these cases, 21.5 percent involved marijuana (United States Sentencing Commission, 2013). Almost all drug trafficking offenders were male, 85.8 percent (United States Sentencing Commission, 2013). Furthermore, the majority of offenders were non-white, with Hispanics and African-Americans making up 47.9 percent and 26.7 percent of offenders respectively (United States Sentencing Commission, 2013). 49.5 percent of offenders had little or no prior criminal history, but 16.3 percent of those convicted had their sentences increased because they were in possession of a weapon (United States Sentencing Commission, 2013).

A team of researchers studied state panel data to look at the differences in crime between states with legal medical marijuana and states without any form of legal marijuana. Researchers looked at Part I offenses: homicide, rape, robbery, assault, burglary, larceny, and auto theft (Morris, TenEyck, Barnes, & Kovandzic, 2014). Data were obtained from the FBI's Uniform Crime Reporting Program from 1990 to 2006 (Morris, TenEyck, Barnes, & Kovandzic, 2014). At the time that the study was conducted, eleven states had medical marijuana legislation: Alaska, California, Colorado, Hawaii, Maine, Montana, Nevada, Oregon, Rhode Island, Vermont, and Washington (Morris, TenEyck, Barnes, & Kovandzic, 2014). Researchers found that medical

marijuana legislation did not indicate an increase in crime rates, and may be associated with a reduction in homicide and assault (Morris, TenEyck, Barnes, & Kovandzic, 2014).

CHAPTER III: METHODS

Despite the vast amount of information that the literature provided, the current study seeks to synthesize the existing knowledge about marijuana's impacts on health and safety and project the consequences of marijuana's legalization onto the United States as a whole. This study examines the effects that legalized marijuana will have on public health and safety in the United States, as opposed to in particular states.

The research questions guiding this research are:

1. Will the legalization of marijuana have a positive or negative impact on public health in the United States?
2. How will legalized marijuana affect roadway safety in the United States?
3. Will the legalization of marijuana reduce violent crime in the United States?
4. Have state or local agencies started preparing for legal marijuana, and what kinds of preparations are they making?
5. Will legalized marijuana be a net cost or net benefit for Americans?

Research Design

While broad surveys of public opinion can provide generalized information that is useful for researchers and policymakers, they cannot provide the level of detail necessary. It is for this reason that one-on-one interviews with persons employed in specialized positions that interact with marijuana to some degree were chosen for the present study. Personal interviews gave participants the ability to describe their answers and opinions in greater detail than would have been possible on a generalized survey. Furthermore, participants had the freedom and ability to discuss points of view that had not been

previously considered by the researcher. While interview results tend to be considered more anecdotal than those of surveys that have undergone statistical analysis, personal interviews provided a greater level of depth and insight into the current research questions. Finally, legislators will need to rely on the specialized knowledge of individuals and organizations dealing with marijuana in varying ways when considering marijuana legislation, as opposed to broad public opinions. For all of these reasons, it was determined that personal interviews would be the most effective research method for the current study.

Participant Recruitment

Approximately 15 potential participants were contacted by email, giving the details of the current study and asking if they would like to participate in an interview (see Appendix for Recruitment Script). They were assured of their anonymity in their participation. Participants were not provided with any reward for participating, monetary or otherwise. Additionally, there was no cost to potential participants for not agreeing to participate in the study. Potential participants were all contacted individually to ensure that their contact information was not distributed to others. Potential participants were contacted through organizations found online, such as a group sponsoring marijuana legislation or police departments, or through academic connections. From there, persons interested in participating in the study were able to contact the researcher individually by email or by telephone.

Participants

Five of the persons contacted by the researcher agreed to participate in the present study. Participants were assigned a number as a way of referencing them in the study while still protecting their identity. The participants were, in no particular order:

1. A pro-legalization state representative in a mid-size Western state
2. A school district police officer in a large metropolitan area
3. A criminal defense attorney in a large metropolitan area specializing in DUI and drug defense
4. A pro-legalization law enforcement officer in a large Western state
5. A former undercover law enforcement officer in a Western Canadian province

Participants will be referred to by their number in this study as a way of protecting their anonymity and maintaining consistency.

Interview Process

Participants were able to specify the meeting time and place for their interviews. Participants were read a script detailing their informed consent and their rights as participants in the study. Participants then verbally gave their consent to participate, but did not sign the informed consent form in order to protect their anonymity. Participants were given a copy of the informed consent script for the researcher's contact information and for their own records. The researcher then asked 8 structured interview questions.

The questions asked were as follows:

1. Are you over the age of 18?
2. Please tell me how your [agency/office] is involved with marijuana and issues related to marijuana.

3. Will the nature of your work change if marijuana is legalized? If so, how? If not, why not?
4. Has your [agency/office] already began making preparations for marijuana legalization? What kinds of preparations are being made?
5. Will marijuana legalization affect your [agency/office]'s relationship with the public? If so, how?
6. In the eyes of your [agency/office], will marijuana legalization be a good or bad thing?
7. What kinds of consequences will marijuana legalization have on the public?
Benefits?
8. Are there any consequences of marijuana legalization that are being discussed by your [agency/office] that are not being discussed by the public? Why do you think so?

Participants were free to expand or elaborate on any question or answer that they saw fit. Each interview took between 30 and 60 minutes depending on the participant, with no interview lasting over 60 minutes. Participants were not recorded in any way, and the researcher took notes on responses.

Result Recording

The researcher manually recorded participant responses. No interviews were video or audio recorded to protect participant anonymity. For this reason, very few exact quotes were used in the results and discussion sections of the present study. Results were presented by question rather than by participant in order to most clearly state each participant's responses.

CHAPTER III: RESULTS

Interview Results

Please tell me about how your [agency/office] is involved with marijuana and issues related to marijuana.

Participant 1 is a state representative in a mid-size state that is actively working on marijuana legislation. The district that Participant 1 represents is located in a large metropolitan area and populated by a wide variety of constituents, varying from citizens below the poverty level to some of the wealthiest residents of the state. The state is rolling out medical marijuana legislation, including licensing dispensaries and issuing medical marijuana cards to qualifying patients. Participant 2 is a school police officer that enforces strict anti-drug laws on high school campuses and deals with students that come to school under the influence or in possession of marijuana and/or other substances. Participant 2 works in one of the largest school districts in the United States, with over 300,000 students registered. Participant 3 is a criminal defense attorney that deals mainly with DUI and small drug charges in a large metropolitan area. Many of the clients that they represent are marijuana users and are facing either DUI or possession charges. Participant 4 is a law enforcement officer in a large metropolitan area that supports the legalization of marijuana, but still must enforce the federal and state laws against the substance. Participant 4 also works in a state that is implementing new medical marijuana legislation. Participant 5 is a former undercover law enforcement officer and trainer in a Western Canadian province. They dealt primarily with weapons cases, but many cases involved the trafficking of marijuana in addition to other criminal activities.

Will the nature of your work change if marijuana is legalized? If so, how? If not, why not?

Participant 1 felt that the nature of their work would change if marijuana were legalized. They stated that one of the major platforms that they ran on when running for office was the legalization of marijuana, and if the substance were legalized their mission in government would be fulfilled. Participant 2, however, stated that the nature of their work would not change. They would still have many other laws to enforce, and would still need to protect the children in their school district. They also assured the researcher that, depending on the marijuana legislation passed, students would still be banned from using or possessing the substance on school grounds. Participant 3 said that their work would change dramatically, but only in the short-term. Because a large percentage of Participant 3's clients are marijuana users and are in trouble with the law as a direct consequence of their use, decriminalizing or legalizing marijuana would remove much of their business. On the other hand, Participant 3 noted that their business would not be affected too much in the long term due to DUI laws and other drug usage.

Participant 4 stated that their job would change "very much so," but in a positive way. They noted that law enforcement will drastically change in their area if marijuana is legalized because so many of their calls deal with marijuana in some way, whether possession, use, or violent associated crime. Furthermore, Participant 4 pointed out that law enforcement from a roadway safety standpoint would change immensely if marijuana were legalized because officers will have to be trained on identifying marijuana impairment more specifically. Participant 5 stated that their job would change significantly if marijuana were legalized in the U.S. Because the U.S. black market is

such a large purchaser of Canadian marijuana, Participant 5 said that legalization in the U.S. would decrease illegal activity related to marijuana in Canada. They discussed how the marijuana industry in their province became so profitable due to the large U.S. market. Since the relaxation of marijuana laws in California, Washington, Oregon, and Colorado, traffickers have faced decreasing profits. The element of criminality and violence of marijuana growers and traffickers in the province would shift to another market if marijuana were legalized in the U.S.

Has your [agency/office] already began making preparations for marijuana legalization?

What kinds of preparations are being made?

Participant 1 stated that they are making personal preparations for marijuana legalization in their state, including reviewing existing legislation in other states and considering additional legislation to protect marijuana users. For example, Participant 1 discussed several possibilities for making reparations to citizens that were convicted of felonies under marijuana prohibition. Participant 1 also noted that legislators in their state are already beginning to work together to discuss an upcoming bill for recreational marijuana use. Participant 1 said that they are also simultaneously working on gaining signatures for a petition to place recreational marijuana on the state ballot in 2016 because they do not believe that the state legislature will pass recreational marijuana legislation. Participant 2, though, stated that no preparations were being made in their office. They said that they are waiting to see what happens before they make changes to their policies and procedures. They are continuing to enforce the rules and regulations that they operate under and will not change until they are legally required to do so.

Participant 3 answered similarly to Participant 2. They stated that they are waiting for Federal rulings on marijuana before changing their business practices. Participant 3 was especially anxious to see Supreme Court rulings on certain areas surrounding marijuana law, including employment discrimination and DUI enforcement.

Participant 4 said that their office is making internal preparations for marijuana legalization, such as making changes to sick leave orders and policies. Participant 4 brought up the Americans with Disabilities Act and emphasized the ways in which medical marijuana will fall under existing ADA policy. In their agency, persons using marijuana for medical purposes will be treated exactly the same way as persons using prescription opioids or benzodiazepines for medical purposes. However, Participant 4 stated that their agency is not making any preparations for recreational marijuana legislation yet. Participant 5 also stated that their agency had not started making any preparations for legal marijuana in the U.S. They talked about the relationship between law enforcement and social support, stating that it became increasingly difficult to enforce marijuana prohibition once society became more accepting of marijuana use.

Will marijuana legalization affect your [agency/office]'s relationship with the public? If so, how?

Participant 1 was not sure how marijuana legalization would affect their relationship with the public. They speculated that it would depend on the success of the legislation, and the economic impact it would have on their state. They believed that their constituents would be happy with new marijuana legislation, particularly for recreational use. They said that it would bring increased freedom to the public, which would

positively impact their relationship with the public. Participant 2 said that legalization would “definitely” affect their relationship with the public. Because they work with minors, Participant 2 felt that all of the problems associated with marijuana legalization affecting minors would be blamed on law enforcement. For example, an increase in adolescent marijuana users would be blamed on law enforcement by parents who felt that their children were not being adequately protected. Participant 3 did not feel that marijuana legalization would affect their relationship with the public. Participant 3 noted that many defense lawyers are perceived as more empathetic with the public, and that this translates into a positive relationship with the public. Changes in marijuana legislation would not change this relationship.

Participant 4 said that marijuana legalization would have a strong positive impact on their agency’s relationship with the public. Participant 4 said that law enforcement currently has a negative reputation when it comes to marijuana because officers are seen as harsh and intrusive on private matters. Legalizing marijuana would open up dialogue between law enforcement and the public, creating a relationship that is more protective and educational. Furthermore, Participant 4 discussed the relationship between law enforcement and minority and low socio-economic citizens. These populations are disproportionately affected by enforcement of marijuana prohibition. By legalizing marijuana, these populations would see less violent and harmful interactions with law enforcement and improve the relationship between them. Participant 5 similarly said that legalized marijuana in the U.S. would affect Canadian law enforcement’s relationship with the public. They specifically discussed how legalized marijuana would impact law enforcement’s ability to identify and prosecute DUI cases. Furthermore, Participant 5

expressed concern about how law enforcement would interact with the public in terms of regulating content. For example, how would law enforcement be able to get involved if dispensaries were selling product laced with dangerous drugs such as PCP? Participant 5 also noted that law enforcement would necessarily shift towards an “engaging with the public” model, making sure that the public is educated and informed about marijuana use.

In the eyes of your [agency/office], will marijuana legalization be a good or bad thing?

Participant 1 said that marijuana legalization would definitely be a very good thing in the eyes of their office. The participant discussed the various economic benefits that marijuana tourism would bring the state, as well as the increased personal freedoms that citizens would enjoy. Patients with chronic diseases would have more freedom in making decisions about their medications and treatments, and it would provide terminally ill patients with more humane pain management. Participant 1 also noted the positive impact that legal marijuana would have in patients that currently have prescriptions for opioids and benzodiazepines. These patients will now have greater freedom in choosing treatments that are best for them, and will be able to avoid the long-term side effects that are caused by chronic opioid and benzodiazepine use. Participant 2, however, said that legalization would be a bad thing. They discussed several reasons for this view including graduation rates and substance abuse. Participant 2 said that from personal experience, marijuana use in adolescents leads to poor school performance and lower graduation rates. If marijuana were legalized, it would be more readily available to adolescents and cause graduation rates to plummet. The participant also questioned where society would stop when it comes to the legalization of drugs. For example, if marijuana were legalized,

would the public work on legalizing more dangerous substances such as cocaine and heroin next? Finally, Participant 2 stressed the issue of DUI, especially in adolescent populations. They stated that adolescent drivers are already at greater risk of being involved in driving accidents and taking greater risks behind the wheel, and having easier access to intoxicants would increase the number of accidents and deaths of adolescent drivers. Participant 3 said that marijuana legalization would be more neutral than good or bad in the eyes of their office. The void created by marijuana legalization will be filled by other cases. Participant 3 also noted that in their personal belief, marijuana legalization would be good for Americans. They discussed new research being published demonstrating the pharmaceutical benefits of marijuana, and the availability of other substances such as alcohol, tobacco, and caffeine.

Participant 4 stated that the law enforcement community is very divided on the issue of marijuana, and that it is too difficult to make a broad statement on how the entire agency views the possibility of legalization. The participant stated their personal belief that marijuana legalization will be a good thing, and that the law enforcement community will face a slow transition to seeing the benefits of legalization. Participant 5 stated that they believed that the question could not be answered with a simple, “yes” or “no.” They said that in some ways legalization would be a good thing, and in some ways it would not. They stated that from a law enforcement perspective, drug enforcement is a way that officers can “play trick-or-treat” and get paid to work overtime. Drug enforcement also involves the death of police officers and citizens, and legalization would likely decrease these deaths and decrease police spending. However, Participant 5 noted that the marijuana being sold and used today has much higher THC content, sometimes as high as

20 percent, and this could bring more problems for public mental health. However, only legalizing strains with lower THC content would create a black market for higher THC product. The participant discussed the ways that marijuana prohibition has stereotyped users, and that legalizing marijuana may reduce the stigma faced by casual or medical marijuana users. Participant 5 discussed the fact that there are people that ruin their lives on alcohol and questioned whether we need to legalize another avenue for citizens to do themselves harm.

What kinds of consequences will marijuana legalization have on the public? Benefits?

Participant 1 did not believe that marijuana legalization would have any consequences on the public. They did list several benefits, though. First, they stated that legalizing marijuana would clear out the justice system and allow law enforcement and the courts to focus on more serious and violent criminals. Second, legalization would allow for the creation of a legitimate system for consumers to purchase marijuana. This would protect consumers because they would be able to make more informed choices. Third, it would eliminate the black market and decrease the violence associated with illegal sales. Fourth, it would increase tourism to their state and bring in more revenue.

Participant 2 said that there would be very few benefits seen by the public if marijuana was legalized, but there would be lots of consequences. To begin with, school performance and participation would plummet, causing high school and college graduation rates to drop. The participant also noted that legalized marijuana would lead to higher rates of substance abuse and use of harder drugs because marijuana is a “gateway drug”. Participant 3 said that there would be benefits as well as consequences from

legalization. A legitimate marijuana market would allow us to better treat chronic or terminally ill patients with more compassion as well as increase personal freedoms. However, it will necessarily change the ways that we deal with adolescents in terms of education about substances and abuse. The participant noted the conversations that they would have to have with their own children regarding marijuana and its use. They said that the conversations would have to become more educational and informative, rather than simply focusing on marijuana's illegality.

Participant 4 said that marijuana legalization would have the same affect on the public as the end of alcohol prohibition. Legalization would decrease violence and the “under culture” of marijuana use. It would bring millions of dollars into the legitimate market, increasing tax revenue for states and decreasing crimes associated with illicit sales. Participant 5 stated that the legalization of marijuana would allow law enforcement agencies to focus on other forms of criminal activity. Legalizing marijuana would give society a safe avenue for indulging without stigma. It would also allow users to get decent medical advice about their use without feeling like a criminal or needing to hide their habits from medical professionals. Participant 5 discussed the idea of regulation and taxation, and stated that they “don’t really buy into” the taxation model. They pointed out that the money collected in tax revenue from marijuana sales would have to be used on regulators and other personnel that would absorb tax revenue in the form of salaries and benefits. Participant 5 also stated that any time there is money involved in a system, there will always be someone trying to figure out a way around that system. Legalizing marijuana would not completely eliminate crime in the ways that some legalization advocates proclaim. Furthermore, Participant 5 brought up the possibility of making

marijuana safer for people to use by bringing it into the legitimate market. Regulations would help to ensure that unsafe chemicals are not used during the growing process, such as harmful pesticides and fertilizers. Legalizing marijuana could give consumers more control over choosing products that are grown safely and responsibly.

Are there any consequences of marijuana legalization that are being discussed by your [agency/office] that are not being discussed by the public? Why do you think so?

Participant 1 said that there are no consequences being discussed by their office that are not being discussed by the public. They emphasized the availability of information available to the public and that their office has no more information than the public does. Participant 1 also stated that their constituents are well informed and have taken a lot of time to research marijuana and its consequences. Participant 2 said that they do not believe that the public is considering how marijuana legalization will affect education enough. They said that they are not sure as to why the public is not considering education, but that it should be examined more carefully. They said that people typically do not associate education and substance abuse because they underestimate the number of minors that use illicit substances. Participant 3 stated that there are no consequences being considered by their office that are not being discussed by the public.

Participant 4 said that law enforcement is not discussing any more consequences than the public because law enforcement is a “microcosm of the public”. The participant did discuss the probability of short-term “sacrificial lambs” in the court system as states pursue marijuana legislation. They brought up cases in Colorado currently working up the court system involving employee rights in using marijuana during their personal time.

The participant noted that because there is a large absence of marijuana case law in areas where marijuana is legal, there would necessarily be cases prosecuted so that legal precedence can be set. Participant 4 stated that this would be especially important in marijuana DUI cases because the research in that area is so limited. Participant 5 stated that he was not aware of any potential consequences being discussed by their agency that are not being discussed by the public. They stated that the biggest issue in the way of legalization and regulation is the problem of quantifying and measuring impairment to prosecute DUI. They stressed that the important thing about legalization is giving the police the tools that they need to do their jobs, to safeguard people against those that abuse the systems in place. All systems will have some faults, but there are still discussions that need to be had to determine the safest and most effective ways of regulating marijuana.

CHAPTER V: DISCUSSION

The answers collected by the researcher during interviews provided insight into how the legalization of marijuana will impact specific professions dealing with public health and safety. In this section, the impacts brought up by participants will be discussed in greater detail and applied to existing literature.

Public Health

Despite the numerous existing studies that demonstrated the potential negative health effects caused by marijuana use, particularly in adolescent users, three of the five participants discussed the positive health benefits to be gained by legalizing marijuana. Participants emphasized the treatment of chronic and terminal illnesses as huge positive consequences of marijuana use. They discussed the positive impacts that legalized marijuana would have on public health in general, stemming from giving patients greater control over their own treatments and from regulation of growing processes and THC content. This could reduce the likelihood of marijuana users consuming products that are laced with more dangerous drugs and decrease the negative health consequences associated with those substances.

The pro-legalization participants seemed much more eager to present marijuana as a safer alternative to more commonly used substances such as prescription painkillers, rather than as a completely harmless substance. Legalizing marijuana could increase the possibility of reducing the number of Americans taking prescription benzodiazepines and opioids. Researchers are now finding that long-term use of these prescription drugs is extremely harmful to neurological health, and may contribute to the development of

dementia in elderly patients (Billioti de Gage; Moride; Ducruet; Kurth; Verdoux; Tournier; Pariente; & Bégaud, 2014). Marijuana, however, has yet to have a demonstrated effect as drastic as opioids and benzodiazepines. Providing a safe and effective alternative for these medications could also potentially reduce the number of prescription drug addicts and abusers in the U.S. As the number of prescription drug addicts has increased in the U.S., the number of heroin users has also increased. By giving patients who would otherwise be treated with prescription drugs an alternative treatment option, it is possible that these patients would be prevented from developing addictions that push them into riskier behaviors. Depending on the legislation passed, this could also lower healthcare costs due to decreases in prescription drug purchases.

The legalization of marijuana could also have an effect on the use of other illicit substances. Taking marijuana off of the black market and creating a legitimate market for its sale would no longer expose consumers to criminals with access to harder drugs. Consumers without legal access to marijuana are forced to purchase from dealers that have access to harder drugs and violent criminal activity. This could make the transition from marijuana use to harder drug use easier, because the contact has already been made. In no way will illicit drug use cease entirely if marijuana is legalized in the U.S., but it is possible that the number of illicit drug users would decrease. Furthermore, law enforcement would be able to shift its attention to harder substances such as heroin and methamphetamine if marijuana were legalized. Marijuana users would also be able to report unsafe products to law enforcement. For example, a consumer that purchased marijuana laced with PCP, a dangerous hallucinogenic substance, could report the purchase to regulators and help remove the substance from the market.

Another potential benefit of legalizing marijuana on public health would be regulation of growing processes and techniques. Currently, marijuana consumers have very little information about the product that they purchase. Growers are not required to use safe chemicals in the growing process and their product is not regulated. Growers have the ability to use heavy pesticides that are illegal to use because they are unsafe for human consumption, as well as damaging to the environment. Participant 5 discussed the dangers of using marijuana grown with the use of heavy pesticides. Legalizing marijuana could ensure that consumers are getting a safer product that is free from unsafe or unsanitary fertilizers and/or pesticides.

Three of the participants that supported legalization were skeptical of the studies that demonstrated negative effects of marijuana use in adults, but recognized the problems that are caused by adolescent use on brain development. It is possible that pro-legalization participants discredit older studies that demonstrated marijuana's harmfulness because they were funded by agencies that sought to keep marijuana classified as a Schedule I substance. Advocates of legal marijuana argue that all federally funded research on marijuana is inherently not credible due to the federal government's stance on the substance (Kovaleski, 2014). Researchers would therefore be motivated to demonstrate findings consistent with the government's position in order to secure future funding. However, research being conducted today in states where marijuana is legal still demonstrates some negative health effects of marijuana consumption.

On the other hand, the refusal to acknowledge negative information about marijuana could be a combination of confirmation bias and belief perseverance. Because the participants support the legalization and use of marijuana, they are more likely to

discredit information that does not support their beliefs. The same is true of the participant that was against the legalization of marijuana, but they are more likely to dismiss recent studies illustrating the relative safety of marijuana use. It is likely that the debate about the legalization of marijuana will continue to be lively and politicized because of cognitive biases and entrenched beliefs on both sides.

Public Safety

Only one of the pro-legalization participants discussed any negative effects of legalization on public safety. The anti-legalization participant, however, brought up the issue of driving under the influence (DUI). Both Participant 3 and Participant 5 stressed the importance of developing standardized methods of detecting and measuring marijuana intoxication. The participants both called for more research and hoped that improving technologies would provide law enforcement with tools similar to those that exist for alcohol. Even amongst the pro-legalization participants, there was no consensus or cohesive strategy for resolving the issues of identifying and prosecuting drivers under the influence of marijuana. This mimics the uncertainties illustrated by research in terms of developing an impairment curve similar to that of alcohol. The anti-legalization participant was very outspoken about DUI and marijuana use, especially in adolescent drivers. This argument does have merit, as adolescent drivers are already more likely to participate in more risky driving behaviors and to underestimate the dangers of driving under the influence. The number of teen driving fatalities dropped significantly in the U.S. after the drinking age was raised to 21 years, but alcohol still remains the most commonly used substance among teens aged 12 to 18 (Carpenter & Dobkin, 2011). Anti-legalization advocates argue that legalizing marijuana will increase underage use of the

substance and lead to an increase in the number of adolescents that drive under its influence. This is difficult to prove, even in states where marijuana is now legal. The number of drivers that test positive for cannabinoid metabolites has risen in Colorado following the implementation of its marijuana legislation, but this does not necessarily mean that all of those drivers were impaired at the time of arrest. Only further research will be able to provide more concrete answers and solutions to the problems presented by marijuana by driving behavior and safety.

Only two of the participants brought up the possibility of weakening criminal drug trafficking organizations by legalizing marijuana. Though this is frequently discussed in pro-legalization debates, it seems that this point is of lesser importance to marijuana advocates. This could be due to a variety of reasons. In this case, I believe that the participants that did not bring up drug trafficking organizations did not have any direct experience with violence caused by these organizations. In their personal lives, the lessening of cartel violence would be a secondary or tertiary benefit. The participants that did discuss cartel violence and the weakening of drug trafficking organizations are law enforcement officers that have experience dealing with drug violence. Weakening the cartels by legalizing marijuana would have a direct impact on those participants' agencies. Interviewing other law enforcement officers in areas near the southern U.S. border would be interesting to determine how prevalent cartel violence is, and if the legalization of marijuana would actually lessen this violence.

The pro-legalization participants were eager to discuss how legalizing marijuana would lower incarceration rates in the U.S. and lessen the criminality of marijuana use. Participants discussed how the legalization of marijuana would lessen users to exposure

to more violent criminal activity that is associated with the sale of marijuana, including illegal weapons, assault, and money laundering. This is an area of legalization that will be extremely difficult to predict. It is unclear exactly how the legalization of marijuana could impact public safety in terms of violent crime. Only time will illustrate the complex relationship between marijuana use and crime. For the time being, lawmakers can look to states like Colorado and Washington to provide better data.

Limitations

While the present study provided a more in-depth view of how the legalization of marijuana will impact public health and safety, it did have several limitations. First, the scope of the study was narrow. Only a limited number of interviews were conducted, making the possibility of skewed results much greater. Second, interviews come with the involvement of personal bias. Each participant interviewed brought individual beliefs and experiences that make up their opinions on the legalization of marijuana. As mentioned earlier, confirmation bias and belief perseverance can significantly affect the interpretation of new information. Personal interviews are susceptible to these biases and do not provide controlling measures. Finally, the interpretation of interviews is subjective and not based on statistical analysis.

Implications for Future Research

The present study provides a starting point for further research into how the legalization of marijuana will impact public health and safety. The answers given by interview participants provide insight into how members of different agencies and organizations are preparing for the possibility of legalization. The study illustrates the differences in opinions that still exist regarding marijuana. Further research into

marijuana's effect on driving behavior is needed before fair and effective DUI legislation can be implemented. Additionally, more research is needed on the impairment curve of THC and potential ways of identifying recent marijuana use as opposed to residual cannabinoid metabolites.

States considering marijuana legislation can look to Colorado and Washington to better understand how legalization would impact violent crime. However, the complex nature of the relationship between legal marijuana and violent crime will present many challenges to individual states. Much of the data will depend on the states and their populations, leaving lawmakers unable to precisely determine how legalizing marijuana would affect violent crime.

In regards to public health, further research is needed on the long-term effects of marijuana use. Comparing marijuana consumption to alcohol or prescription drug use could provide lawmakers with better information for restricting the sale of marijuana if it becomes legal. Existing literature has demonstrated the negative effects of marijuana use in adolescents, but a better understanding of exactly how marijuana use impacts brain structure and function is needed. For example, it is currently unclear if the differences in brain structure between marijuana users and non-users are caused by marijuana use or if the differences in brain structure are associated with a higher likelihood of risky behavior. Marijuana and its impacts on neuropsychological health are complex and further research is needed to understand exactly how the brain is affected by marijuana use.

CHAPTER VI: CONCLUSION

The present study sought to identify the potential consequences of the legalization of marijuana on public health and safety in the United States. Existing literature on marijuana's impacts on neurological and psychological health, and the various ways in which marijuana and its use affect public safety, was first examined. Despite multitudes of existing studies, researchers are still unclear about exactly how marijuana use affects brain structure and function. Furthermore, it is unclear how marijuana use affects other aspects of personal health, such as lung function or psychological health. Research has demonstrated that marijuana intoxication impairs driving behavior and decision making, but researchers have not yet identified an impairment curve for cannabinoids. It is not possible to extrapolate past impairment with marijuana, unlike alcohol. This makes DUI legislation for marijuana more complicated than that of alcohol. Finally, the correlation between marijuana use, availability, and violent crime is difficult for researchers to determine.

One-on-one interviews with various professionals employed by organizations that deal with marijuana in various ways were conducted. Five interviews were conducted with participants in the following professions: a pro-legalization state legislator, a school district police officer, a criminal defense attorney, and a pro-legalization law enforcement officer, and a former undercover law enforcement officer in Canada. These interviews provided insights into how the legalization of marijuana would affect each individual organization. The pro-legalization participants discussed the positive benefits that legalized marijuana would have on healthcare and the treatment of chronic and terminal

conditions. They also considered the possibility that legalizing marijuana would decrease violence by removing drug trafficking organizations from power. However, the anti-legalization participant brought up the problems that could arise from legalized marijuana. They strongly believed that legalizing marijuana would have strong negative effects on adolescents in terms of both health and safety.

Both the literature review and interview process illustrated the gaps in understanding of the complexities of marijuana and how it impacts society as a whole. While science has demonstrated the personal effects that marijuana consumption has, it has been thus far unable to show exactly how widespread marijuana use impacts public health and safety. This demonstrates, more than anything else, that marijuana is an incredibly complex substance that we have not yet been able to completely understand. As more neuropsychological research provides better insights into brain structure and functions, scientists will be able to better understand how psychoactive substances such as THC affect the brain. Furthermore, this research would provide law enforcement with better knowledge of how THC intoxication impacts driving behavior.

The literature review provided insights into how marijuana use impacts individual consumers both physically and psychologically. Much of the information available for marijuana use and violent crime consisted of raw crime data, essentially providing the personal risks associated with marijuana use. The interviews conducted, however, painted a broader picture of the impacts on American society by marijuana use. While some participants did have working knowledge of studies on marijuana use, many participants had a very limited understanding of the scientific intricacies of exactly how marijuana affects both brain and behavior. Together, the literature review and interview results can

provide policymakers with enough information to consider what kinds of marijuana policy may be best suited to the needs of their constituents.

The disparities between the opinions of the interview participants and the findings of existing literature illustrated the larger issues faced by policymakers in considering marijuana legislation. Confirmation bias and belief perseverance make it difficult to have unbiased discussions about marijuana. Many lawmakers and Americans have entrenched beliefs that will be difficult to overcome. Both those that are against the legalization of marijuana and those that are advocating for its legalization have strong beliefs that are grounded in emotions and inaccurate information. The biggest problem for policymakers considering marijuana legislation will be finding objective and credible sources of information that can steer the policymaking process and ensure the safety of constituents.

Going forward into the future, it is difficult to determine if marijuana legislation will be the result of popularity or advances in research regarding the effects of marijuana use and how these effects impact roadway safety. More research is needed to determine exactly what kinds of long-term effects marijuana use has on neurological and psychological health. Additionally, researchers need to identify better and more standardized methods of determining impairment. Until researchers are able to provide lawmakers with better information regarding marijuana's impairment curve, legislation to combat DUI will be either too harsh or ineffective. It will also be difficult to determine exactly how other types of crime and violence will be affected if marijuana is legalized. Policymakers will need to evaluate the information that they use when considering marijuana legislation and be sure that they are using the most objective and recent studies, lowering the likelihood that they will rely on information that is biased or

inaccurate. As public opinion changes and the debate about the legalization of marijuana becomes more emotionally charged policymakers will need to consider the needs of their constituents and evaluate the specific legislative challenges that marijuana will present. Despite the gaps in research and the differing opinions on both sides of the argument, policymakers will be able to find legislative solutions that protect both the health and safety of citizens using existing literature and considering the opinions of field experts.

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